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(71) Applicant:
**GUINNESS BREWING WORLDWIDE LIMITED**
**London NW10 7RR (GB)**

(72) Inventors:
- **Lynch, Francis Joseph, Dr.**
  **Glenageary, Country Dublin (IE)**
- **Quinn, Thomas Patrick**
  **Swords, County Dublin (IE)**

(74) Representative:
**Walters, Frederick James et al**
**Urquhart-Dykes & Lord**
**91 Wimpole Street**
**London W1M 8AH (GB)**

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## (54) Beverage package

(57) A beverage package in which the closure includes a manually openable vent that reduces a head-space pressure in the sealed package to atmospheric pressure for gas to be injected into the beverage through the aperture (15) for froth development prior to removal of the closure from the bottle.

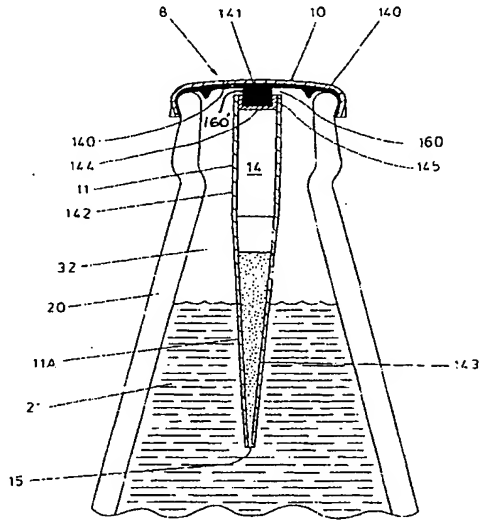


FIG.10

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## Description

This application is divided from EP Application 95 306181.9, published as EP-A-0 701 966. That application describes a beverage packaging method and apparatus.

Sealed beverage packages are known where the beverage is accommodated in a primary chamber of a sealed container having a secondary chamber containing gas under pressure and in which the secondary chamber communicates with the beverage in the primary chamber through a restricted aperture. Upon opening of such a known package for beverage dispensing, a pressure differential is developed which causes the gas in the secondary chamber (possibly preceded by beverage which may have entered that chamber) to be ejected by way of the restricted orifice and such ejection of the gas and/or beverage into the beverage in the primary chamber causes, or assists in, the formation of a head of froth on the beverage by the evolution of gas dissolved therein. Beverage packages having these froth developing characteristics together with methods and apparatus for providing the beverage packages are disclosed in our British Patent specifications Nos 1 266 351, 2 183 592A, 2 256 628A and 2 260 315A. Beverage packages made in accordance with GB 2 183 592A have met with considerable commercial success, especially in the brewing industry for the packaging of fermented beverage such as ale, lager or stout where the advantages of the package and the technical characteristics required for froth development are now fully established and understood by persons skilled in the relevant art. This commercial success has been achieved by packaging the beverage in light metal alloy cans with the secondary chamber being formed as a hollow plastics insert submerged in the beverage and frictionally retained against the walls of the can.

It has long been recognised that there is a need to provide beverage packages of the kind discussed above in bottles, typically necked open top glass bottles that are popular in the soft drinks and brewing trade. The use of bottles is attractive commercially since glass is a relatively inexpensive material as compared with metal, it is easily and economically moulded into bottle shape and is aesthetically pleasing. Furthermore glass bottles are environmentally friendly in the sense that the glass is recyclable and the bottles themselves may be returned for cleansing and re-use. Our aforementioned prior Patents mention or infer the use of bottles in forming the beverage package. Of particular relevance on this latter point is the disclosure in G.B. 1,266,351 where the open top of a narrow necked bottle is sealed by a crimped metal or plastics crown cap to the underside of which is attached a hollow insert in the form of a tubular extension that forms the secondary chamber. The tubular extension has at its lower end a restricted aperture which is submerged within the beverage in the primary chamber formed by the bottle. The disclosure in G.B. 1,266,351 is believed to be the most relevant prior art to the present invention and provides the basis for the introduction which precedes the characterising clauses of the independent claims hereto. A headspace in the bottle and the secondary chamber are maintained in equilibrium at a pressure greater than atmospheric so that when the crown cap is removed a pressure differential is developed causing gas in the secondary chamber of the tubular insert to be jetted into the beverage and thereby effect in froth development by the liberation of gas from solution in the beverage. In this prior Patent it is suggested that a method of charging the bottle with beverage and charging the tubular extension with gas is for the bottle to be filled and capped in a region of appropriate gas pressure so that at the end of the capping operation the secondary chamber is pressurised and in equilibrium with the gas that is in solution with the beverage.

The proposal to provide a bottled beverage package of the kind discussed in our G.B. 1,266,351 has been publicly known for more than twenty years and despite this and the long felt need for a bottled beverage which provides, upon opening of the bottle, froth development by automatic injection of fluid into the beverage to liberate gas from solution for froth formation, there is still a requirement for a relatively simple, inexpensive and commercially acceptable method and apparatus by which the beverage may be packaged in bottles. It is an object of the present invention to provide a beverage packaging apparatus and a beverage packaging method which go towards satisfying the aforementioned requirements.

## STATEMENTS OF INVENTION & ADVANTAGES

According to the present invention there is provided a beverage packaging apparatus providing a beverage package of a bottle with a primary chamber charged with beverage containing gas in solution and an openable top sealed by a closure, said primary chamber having therein a hollow insert which provides a secondary chamber and is carried through said openable top, the secondary chamber containing gas under pressure and being open to communication with the primary chamber by way of a restricted aperture through which upon opening of the beverage package, gas or beverage under gas pressure in the secondary chamber is directed into the beverage in the primary chamber to form, or assist in the formation of, froth on the beverage and which apparatus comprises a bottle sealing station at which sealing of the bottle is carried out in a region of appropriate gas pressure following carriage of a said hollow insert through the openable top so that the restricted aperture of the secondary chamber is located beneath the surface of the beverage in the primary chamber; CHARACTERISED BY means for providing at a bottle locator of the sealing station a said bottle in an upstanding open topped condition and charged with

said beverage; the sealing station having a pressure chamber which is openable for at least the open top of the upstanding bottle to be received therein, a closure locator and means for feeding a said closure to the closure locator to locate the closure above the open top of a bottle provided at said bottle locator; means for locating a said hollow insert within the pressure chamber with the restricted aperture open to direct communication with the pressure chamber; means for closing the pressure chamber about the hollow insert, the closure locator and at least the open top of the bottle; gas pressure control means by which the closed pressure chamber and thereby the primary chamber of a bottle and the secondary chamber of a hollow insert in the pressure chamber are pressurised with gas to a predetermined pressure greater than atmospheric; sealing means operable with the pressure chamber closed and pressurised to said predetermined pressure to provide a sealing operation that effects in relative displacement between the closure locator and a bottle at the bottle locator for a closure in said locator to seal the open top of the bottle, said sealing operation further effecting in the hollow insert being captured within the primary chamber and retained to be carried through the openable top so that the restricted aperture of the secondary chamber is located beneath the surface of the beverage in the primary chamber; and means operable following the sealing of the bottle by the closure to reduce the pressure within the pressure chamber substantially to atmospheric pressure and thereafter to open the chamber for removal of the beverage package from the bottle locator.

Further according to the present invention there is a beverage packaging method which provides a beverage package of a bottle with a primary chamber charged with beverage containing gas in solution and an openable top sealed by a closure, said primary chamber having therein a hollow insert which provides a secondary chamber and is carried through said openable top, the secondary chamber containing gas under pressure and being open to communication with the primary chamber by way of a restricted aperture through which upon opening of the beverage package, gas or beverage under gas pressure in the secondary chamber is directed into the beverage in the primary chamber to form, or assist in the formation of, froth on the beverage, the method comprising sequentially, providing a said bottle at a sealing station at which sealing station sealing of the bottle is carried out in a region of appropriate gas pressure following carriage of a said hollow insert through the open top so that the restricted aperture of the secondary chamber is located beneath the surface of the beverage in the primary chamber, CHARACTERISED BY providing at the sealing station the said bottle in an upstanding open top condition and charged with said beverage; enclosing at least the open top of said bottle at the sealing station in a pressure chamber in which pressure chamber is located a said closure in a closure locator positioned above the open top of the bottle and a said hollow insert with the restricted aperture of its secondary chamber open to direct communication with the pressure chamber; pressurising the closed pressure chamber and thereby the primary and secondary chambers to a predetermined pressure greater than atmospheric pressure; displacing the closure locator and bottle relatively towards each other in said pressurised pressure chamber for the closure to sealingly engage with the open top of the bottle and for the hollow insert to be displaced by the closure and captured within the primary chamber to be retained to be carried through the openable top so that the restricted aperture of the secondary chamber is located below the surface of the beverage in the primary chamber; reducing the pressure in the pressure chamber substantially to atmospheric pressure; opening the pressure chamber and removing the beverage package therefrom.

Still further according to the present invention there is provided a beverage package when formed by the beverage packaging method as specified in the immediately preceding paragraph.

By the method and apparatus of the present invention at least the open top of the open topped upstanding bottle may be located in the open pressure chamber with the bottle empty and the bottle subsequently charged with the required volume of beverage whilst in the pressure chamber or the bottle may be delivered to the open pressure chamber having been previously charged with the required volume of beverage containing gas in solution. This latter proposal is preferred for economy and convenience so that the method and apparatus of the invention can, advantageously, be incorporated as part of a conventional bottle filling line from which the filled bottles are delivered sequentially to be received in the open pressure chambers. An open topped bottle may be received within an open pressure chamber so that the pressure chamber, when closed, encloses and accommodates the bottle which is subjected as a whole to pressure variations within that chamber. Preferably however the bottle itself forms a part of the pressure chamber so that only an upper part of the bottle including its open top (and thereby the primary chamber) is subjected to pressure variations in the pressure chamber whilst the lower part of the bottle is maintained exposed to atmospheric pressure. This latter preference is conveniently achieved by arranging for a wall or shroud of the pressure chamber to seal against the external surface of the bottle so that its open top is presented to the pressure chamber thus formed. With conventional bottles having a tapered neck which presents an external shoulder, the aforementioned seal is preferably effected against the external shoulder - this has the advantage that the apparatus may be arranged so that it adapts to different sizes of bottle by sealing about a predetermined circumference on the shoulders of cylindrical bottles but this sealing may be effected at different heights from the bottle base for differently sized

bottles. Understandably the bottle structure should be of adequate rigidity to withstand the sealing pressure against its outer surface but conventional glass or ceramic bottles should not present any problem in this connection. The pressure chambers are conveniently disposed in a circumferentially spaced array on a carousel which rotates for the bottles to be fed successively to the pressure chambers by, for example, star wheels and the sealed bottle packages sequentially removed from the carousel in a similar manner. By enclosing at least the open top of a bottle charged with its beverage in a pressure chamber together with a hollow insert and also a closure for that bottle with the closure positioned by the closure locator above the open top of the bottle, it will be appreciated that both the primary and secondary chambers will be simultaneously subjected to gas pressure variations effected in the pressure chamber. Because of the well known long term detrimental effect of oxygen on the characteristics of beverage, the pressure chamber will usually be pressurised with a non-oxidising gas such as carbon dioxide, argon or nitrogen of which the latter is preferred and will, for convenience, be referred to hereinafter. Nitrogen gas under pressure is admitted to the pressure chamber to provide the predetermined pressure therein and this pressure will be determined by the characteristics required of the beverage package that is to be formed. Understandably the gas pressure in the secondary chamber of the beverage package must be adequate and subsist sufficiently when the package is opened for that pressure to eject from the secondary chamber through the restricted aperture, gas (and/or such beverage as may have entered the secondary chamber through the restricted aperture) with adequate power to liberate gas from solution in the beverage to effect froth development. With this in mind the pressure within the pressurised pressure chamber may be controlled accurately to provide the predetermined pressure appropriate to achieve the power necessary for froth development. With conventional glass bottles the predetermined pressure will usually be restricted to the range 2 to 5 bar for the purpose of satisfying safety requirements and alleviate excessive explosive forces in the event that the sealed bottle is dropped and shattered. The physical characteristics of typical narrow-necked glass, ceramic or plastics bottles to which the present invention may be applied will usually mean that the headspace provided in the primary chamber of the bottle when charged with the beverage can be quite restricted and it may be that a relatively small volume secondary chamber of, say, 2 to 5 ccs, typically 3 ccs (as compared with, say, secondary chambers provided by hollow plastics inserts in commercial beverage cans manufactured in accordance with our proposal in G.B. 2,183,592A which will typically have a volume of 8 to 12 ccs) will be required. With such a small volume secondary chamber in a bottle package a relatively high gas pressure (say in the range 5 bar to 10 bar) may be desirable within the sealed package when the contents thereof are in equilibrium. It has been determined that glass bottles as are conventional for packaging soft drinks and fermented beverages can readily and safely withstand up to 10 bar internal pressure (unlike typical light metal alloy beverage cans where approximately 5 bar may be regarded as a maximum safe internal pressure). As a consequence it should not present a problem subject to satisfying the previously mentioned safety requirements to provide by the method and apparatus of the present invention adequate pressure (from the predetermined pressure in the pressure chamber) in a relatively small volume secondary chamber to effect the required froth development when the sealed package is opened. Having the aforegoing comments in mind the predetermined pressure for the pressurisation of the pressure chamber is preferably selectable in the range 2 bar to 10 bar. The restricted aperture will usually be positioned so that the fluid ejected from the secondary chamber when the sealed package is opened is jetted downwardly or sideways into the beverage and the power of that jet can determine the proportion of the volume of beverage in the primary chamber from which gas in solution is liberated. For example, for some beverages it may be desirable for in relatively small proportion of the beverage in the primary chamber to have gas in solution liberated therefrom in which case the pressure of gas in the secondary chamber may be relatively small to provide a small jetting effect which is nevertheless adequate to effect the required froth development from, say, a shallow upper part of the beverage. With other beverages a high power jetting effect may be required to liberate gas from solution throughout all, or a relatively large proportion, of the beverage in the primary chamber and in such case a relatively high pressure will be provided in the secondary chamber to present a fluid jet which penetrates deeply into the beverage. To achieve these different techniques of froth development the pressure in the pressure chamber may be adjustable to provide appropriate power in the jetting effect for various frothing characteristics as may be required for different beverages that are packaged by the method and apparatus of the invention.

Usually a bottle delivered to the sealing station will have been flushed with nitrogen to displace air therefrom. It is likely however that the hollow insert will be located in the pressure chamber having air in its secondary chamber. Because the secondary chamber is likely to be of a relatively small volume and bearing in mind that air is predominantly nitrogen, when the secondary chamber is pressurised to a relatively high pressure with nitrogen gas in the closed pressure chamber, the proportion of oxygen in the secondary chamber may be so small that its detrimental effect, if any, on the characteristics of the beverage in the bottle (over a reasonable shelf life) can be disregarded. Nevertheless, to alleviate the possibility of atmospheric oxygen contaminating the beverage, it is preferred that when the pres-

sure chamber is closed about the open topped bottle (or at least its open top), the closure and the hollow insert and prior to the pressure chamber being pressurised to the predetermined pressure, that pressure chamber is connected to a vacuum pump substantially to remove gases therefrom (and from the primary and secondary chambers) in preparation to receive the nitrogen gas under pressure.

Whilst the closed pressure chamber contains nitrogen gas at the predetermined pressure the closure locator and bottle are displaced relatively towards each other so that the closure carried by the locator sealingly engages and is secured to the open top of the bottle and this sealing operation causes the hollow insert to be displaced and retained so that the restricted aperture is submerged in the beverage in the primary chamber. The relative displacement between the bottle and the closure locator is conveniently achieved by slidable components of the sealing station which are displaced relative to each other under control of fluid pressure operated rams or cam followers and tracks with which those followers co-operate, for example during relative rotation between the cam tracks and followers effected by movement of the sealing station about a carousel of which that station forms part. The opening and closing of the pressure chamber is conveniently controlled in a similar manner.

Preferably the hollow insert is part of the closure so that when the closure is fed to the closure locator (conveniently by means of a starwheel, chute or similar track) the closure locator simultaneously locates the closure and the hollow insert that it carries within the pressure chamber so that the restricted aperture is open to direct communication with the pressure chamber above the open top of a bottle provided at the bottle locator of the sealing station. With this arrangement and during the sealing operation, the hollow insert can be carried by the closure to be received through the open top of the bottle for the restricted aperture to be submerged in the beverage in the primary chamber. The hollow insert may be formed as an integral part of the closure or as a separate component, typically a plastics moulding, which is firmly secured to the closure, for example, by adhesive, welding or by interlocking or interengaging parts. A preferred arrangement is for the hollow insert to be carried on the underside of a closure cap by mechanically engaging the insert with a sealant or liner that is moulded to the cap, for example by moulding the sealant and forming the insert so that a socket and spigot press fitted coupling is provided therebetween. Accordingly an aspect of the invention provides a beverage package comprising an open top bottle having a primary chamber containing beverage having gas in solution therewith, a cap sealing said open top and removable for dispensing of the beverage, a headspace being provided in the bottle above the beverage containing gas at a pressure greater than atmospheric; a hollow insert carried by the cap and having a secondary chamber, said secondary chamber containing at least gas at pressure greater than atmospheric and the insert having a restricted aperture located beneath the surface of the beverage through which, upon opening of the primary chamber to atmosphere and in response to a pressure differential developed thereby, gas and/or beverage in the secondary chamber is directed into the beverage in the primary chamber to form, or assist in the formation of, froth on said beverage, and wherein the cap has a sealant secured thereto and forming a seal between the cap and the bottle, said sealant being moulded to present a part thereof with which the hollow insert mechanically engages to be carried by the cap. It will be realised that by having the hollow insert as part of the closure, upon removal of the closure the insert will also be removed which is desirable, particularly for the convenience of recycling glass bottles. Alternatively the hollow insert can be located in the pressure chamber within the open top of a bottle as a discrete component separate from the closure. Initially such a located hollow insert is held with the restricted aperture clear of the beverage in the primary chamber as the pressure chamber is pressurised. During the sealing operation relative displacement between the closure and the bottle causes the closure to engage and displace the hollow insert from its initial location further within the open top of the bottle to submerge the restricted aperture in the beverage as the closure is sealingly engaged with the bottle. Such a discrete hollow insert is conveniently retained in position within the open top of the sealed bottle by frictional engagement with the wall of the bottle (neck) (in a similar manner to the disclosure in our G.B. 2,256,628A) or by entrapment between the closure and the rim of the open top of the bottle. Preferably the discrete hollow insert is located in its initial location in the open top of the bottle prior to that bottle being received at the bottle locator of the sealing station so that the hollow insert is carried by the bottle into the pressure chamber.

The bottle closure (preferably having the hollow insert as part thereof) may take several forms of which the simplest is possibly a metal or plastics cap that is crimped or sealed over the open top similar to a conventional "crown cap". Alternatively the bottle closure may have a stopper part which is received as a bung within the bottle through its open top to provide a seal with the internal wall face of the bottle. As a further possibility the bottle closure may be internally or externally threaded to screw threadedly engage with a complementary external or internal thread provided on the bottle.

The present invention was primarily developed for the packaging of fermented beverages such as stout, lager, ale and other beers and cider. It will be realised however that the invention may be applied with advantage to the packaging of other beverages having gas in solution, for example dealcoholised fermented beverages and so-called soft drinks such as colas, lemonade, milk shakes and the like and possibly distilled bever-

ages, where a head of froth is desirable by liberation of gas from solution in the beverage. It will also be realised that where a fermented beverage package is formed by the present invention, such package may contain "live" beverage (such as beer). Live beverage packages are well known in the brewing industry whereby following sealing of the bottle, natural fermentation of the beverage in the sealed bottle continues; this fermentation produces CO2 and can thus increase the pressure within the sealed bottle in comparison with the pressure at sealing.

## DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying illustrative drawings, in which:

Figures 1 to 6 diagrammatically show a first embodiment of beverage packaging apparatus constructed in accordance with the invention and sequentially illustrate successive stages of a beverage packaging method in accordance with the present invention;

Figure 7 illustrates a beverage package formed by the apparatus and method of Figures 1 to 6 where the hollow insert with the secondary chamber is part of the closure;

Figure 8 shows the beverage package of Figure 7 being opened to effect froth development and permit dispensing of the beverage;

Figure 9 shows a modification of the invention in which the hollow insert having the secondary chamber is formed as a discrete component separate from the closure;

Figure 10 illustrates a further beverage package formed by the apparatus and method of Figures 1 to 6 where the hollow insert is part of the closure and is secured to a closure cap by a socket and spigot connection;

Figure 11 illustrates a modification of the socket and spigot connection shown in Figure 10, and

Figures 12 to 17 diagrammatically show a second embodiment of beverage packaging apparatus constructed in accordance with the present invention and sequentially illustrate successive stages of a beverage packaging method in accordance with the present invention.

## DETAILED DESCRIPTION OF DRAWINGS

The present embodiments will be considered in relation to the preparation of a beverage package in the form of a sealed bottle 20 containing in a primary chamber thereof beer 21 such as ale, stout or lager (which may be alcoholic or non-alcoholic) having nitrogen/carbon dioxide gas in solution - an example of such a beverage is discussed in the preferred embodiment of our British Patent No. 2,183,592A. The bottle 20 for the package may be of conventional glass structure having a cylindrical lower part 20A which tapers to a neck 20B having an open top 20C (see Figure 7).

Figures 1 to 6 predominantly show a sealing station 1 and sequential stages in the systematic operation of that station to provide a sealed bottle containing the beverage. In practice the sealing station 1 will be one of an array of several identical such stations circumferentially spaced to rotate as a whole about a vertical axis on a carousel (not shown) which carries the sealing stations 1 so that the sequential operation of each station (as shown successively in Figures 1 to 6) is effected over a major part length of the circumferential path through which the work stations are displaced during a rotation of the carousel.

The work station 1 has a vertically extending tubular shroud 2 that is fixed relative to the rotating carousel. Extending within and through the shroud 2 is a vertical shaft 3 which is slidable vertically relative to the shroud 2 and is sealed relative thereto by a pressure seal 4 at the upper end of the shroud. The lower end of the shaft 3 carries a closure locator 5. Disposed below and spaced from the bottom end of the shaft 3 and concentric therewith is a bottle locator, simplistically shown as a bottle receiving horizontal stand or platform 6, carried at the upper end of a vertical shaft 7. The shaft 7 is concentric with the shaft 3 and is vertically displaceable with the platform 6 relative to the shroud 2. Independent vertical displacement of the shafts 3 and 7 of the work station 1 as necessary during operation of that work station is conveniently controlled by pneumatic or hydraulic rams (not shown) which rams are themselves controlled by valves (not shown) actuated as required by relative displacement between cam followers and cam tracks (not shown) during rotation of the carousel. It will be appreciated however that the aforementioned displacement of the shafts 3 and 7 relative to the shroud 2 can be effected and controlled by any convenient manner including electrically or wholly mechanically.

In the position of the work station 1 shown in Figure 1 the shafts 3 and 7 are lowered to their maximum relative to the shroud 2 and so that the closure locator 5 is exposed and presented from the bottom end of the shroud 2. In this position a closure 8 is fed to be seated in the closure locator 5. The closure 8 is conveniently fed to the closure locator 5 from a chute or other guide track 9 by which the closures are dispensed successively to each sealing station 1 as the station is carried by the rotating carousel to the position shown in Figure 1. As an alternative to providing a closure supply track 9 which is common for all of the work stations 1, each work station may have an independant supply of closures 8 for closures to be fed successively as necessary to the closure locator 5 of that work station, for example such an independant supply may be achieved through the shaft 3.

Examples of several structures suitable for the clo-

sure 8 will be described hereinafter (such structures not necessarily having the reference "8") but preferably the closure 8 comprises a metal or plastics cap 10 which carries a hollow component or insert conveniently formed as a plastics moulding or assembly of mouldings 11 having a tubular extension 11A. A convenient example of the closure 8 is shown in Figures 7 and 10. In Figure 7 the moulding 11 is secured to the underside, of the cap 10 by a tapered grommet 12 locked and sealed in a recessed aperture 13 provided in the cap. If required, the grommet 13 on the hollow moulding 11 can be heat sealed in the aperture of the cap. The hollow moulding 11 together with its tubular extension 11A forms a secondary chamber 14 which opens through a restricted aperture 15 in the free end of the extension 11A. In a typical example the secondary chamber 14 will have a capacity of approximately 3 ccs whilst the restricted aperture 15 is likely to have a diameter in the order of 0.6 millimetres. The tubular extension 11A extends perpendicularly from the underside of the cap 10 and, although this extension is shown offset from the centre line of the cap, it will usually be concentric with the cap 10 for convenience of handling and mechanical feeding of the closures 8 to the closure locator 5. A more preferred form of closure 8 is discussed hereinafter with reference to Figures 10 and 11.

During displacement of the sealing station 1 by the carousel from its position shown in Figure 1 to that shown in Figure 2, the shaft 3 is raised to its maximum height so that the closure locator 5 together with the closure 8 therein is withdrawn into the shroud 2 as shown in Figure 2. With the sealing station 1 in the position of Figure 2, an open topped bottle 20 in an upstanding condition and charged with its required capacity of the beer 21 is positioned on the platform 6. The bottle 20 is conveniently fed to the platform 6 by a star wheel 22 which delivers such bottles sequentially from a conveyor of a conventional filling line along which the bottles are charged with the beer.

During displacement of the sealing station from its position shown in Figure 2 to that shown in Figure 3, the shaft 7 is raised to its maximum height relative to the shroud 2 to lift the platform 6 and bottle 20 thereon so that the bottle is received within the shroud 2 and the platform 6 abuts the bottom end of the shroud 2 and forms a pressure seal therewith. In the position of the sealing station shown in Figure 3 therefore the bottle 20 and the overlying closure 8 are vertically spaced from each other and enclosed within a sealed pressure chamber 25 formed between the shroud 2, the shaft 3 and the platform 6.

Associated with the shroud 2 is a vent valve 26 and a pressurising valve 27 which are conveniently controlled by cam followers (not shown) that move relative to cam tracks (not shown) during rotation of the carousel but may be otherwise controlled, for example by pneumatic rams or electrical solenoids. However control of the valves 26 and 27 is arranged so that with the sealing station in its condition shown in Figure 3, the vent valve 26 is opened to connect the pressure chamber 25 to a vacuum pump by which gases in that chamber together with gases in the headspace of the bottle neck 20B and in the secondary chamber 14 of the bottle closure are withdrawn to remove (or substantially reduce) the content of atmospheric oxygen in the chamber 25. Following exhaustion of gases from the chamber 25 and during displacement of the sealing station from its position shown in Figure 3 to that shown in Figure 4, the vent valve 26 is closed and the pressurising valve 27 is opened so that the latter valve admits nitrogen gas under pressure to the pressure chamber 25. The pressure of nitrogen gas in the pressure chamber 25 will be predetermined depending on the characteristics required of the beverage package which is to be formed, typically the pressure will be 3 bar but it may be adjustable, preferably in the range of 2 bar to 10 bar.

With the pressure chamber 25 at the predetermined pressure (and consequently the headspace in the bottle neck 20B above the beverage 21 and the secondary chamber 14 of the closure also at that predetermined pressure), such pressure is maintained during displacement of the sealing station by the carousel from the position shown in Figure 4 to that shown in Figure 5. During this latter displacement the shaft 3 is partially lowered relative to the shroud 2 so that the closure 8 is carried by its locator 5 to close the open top 20C of the bottle and effect sealing engagement about the rim presented by the neck of the bottle 20 whilst the hollow plastics moulding 11 haying the secondary chamber 14 is received within the neck of the bottle for the free end of the tubular extension 11A to dip into the beverage 21. Consequently the restricted aperture 15 is located beneath the surface of the beer 21 and is directed downwardly towards the bottom of the bottle. Following the positioning of the closure to the bottle and as shown in Figure 5, the closure locator 5 will crimp or otherwise secure the cap 10 to the bottle neck to form and maintain a sealed headspace 32 and thereafter release the closure 8 to the bottle.

During displacement of the sealing station from the position shown in Figure 5 to that shown in Figure 6 the pressurising valve 27 is closed and the vent valve 26 is opened so that the pressure chamber 25 communicates through the valve 26 to be reduced to atmospheric pressure. In addition and when the pressure in the chamber 25 has reduced sufficiently, the shaft 7 is lowered to its maximum extent so that the platform 6 withdraws from the shroud 2 to open the pressure chamber as the sealed beer bottle or package 30 is also withdrawn on the platform from the shroud 2. At the position shown in Figure 6 the bottled beer package 30 is removed from the platform 6, conveniently by a star wheel 31 which displaces the bottle 30 onto an appropriate conveyor. During completion of a revolution of the carousel, the sealing station 1 is displaced from its position shown in Figure 6 to that shown in Figure 1 and during such dis-

placement the shaft 3 is lowered to its maximum extent in preparation for the locator 5 to receive a further closure 8 in the Figure 1 position.

As a typical example the bottle 20 may have a fluid capacity (in its primary chamber) of say 350 cc that is charged with 330 cc of beer 21 to leave a headspace 32 of approximately 20 cc of which the secondary chamber 14 in the plastics moulding 11 may occupy approximately 3 cc. Following from the previously described system for forming the bottle package 30 shown in Figure 7, it will be apparent that when the contents of the sealed bottle are in equilibrium between the primary chamber of the bottle in which the beer 21 is accommodated and the secondary chamber 14, the headspace 32 and the secondary chamber 14 may be at a pressure in the order of 3 bar. Upon opening of the bottle package 30 as shown in Figure 8, typically by deforming the cap 10 with a bottle opener 10A, the pressure in the headspace 32 rapidly reduces to atmospheric pressure thereby creating a pressure differential between the high pressure in the secondary chamber 14 and atmospheric pressure. As a consequence, gas under pressure from the secondary chamber 14 is expelled through the restricted aperture 15 as a downwardly directed jet into the beer 21. This jetting effect causes gas in solution to be liberated from the beer 21 in well known manner for the development of froth which can accumulate in the headspace 32. It is possible that during the pressurising and sealing of the bottle 20 and as the contents of the sealed bottle package come into equilibrium, some of the beer will be taken into the tubular extension 11A as indicated at 21A. In this latter event it will be appreciated that when the pressure differential develops on opening of the bottle package 30, the beer 11A will initially be ejected through the aperture 15 to cause froth development and that such ejection of the beer will be followed by ejection of a mixture of gas and beer and then solely gas. Following partial removal of the crimped cap 10 and initiation of froth development with the aperture 15 beneath the surface of the beverage 21, the closure 8 (which includes the moulding 11) can be removed completely from the bottle to permit dispensing of the beer 21.

A more preferred form of the closure 8 is shown in Figure 10 in which the cap 10 is provided on its underside with a resilient liner or sealant 140 which, when the cap 10 is crimped to the bottle neck, forms a seal between the cap and the rim of the bottle mouth. The sealant, which may be of a plastics material conventional for seals or liners on crown cap bottle closures, is moulded to the cap 10 and during such moulding a spigot 141 is formed of the sealant to project centrally from the cap. The hollow plastics insert 11 in the example of Figure 14 has an elongated moulded structure comprising an upper tubular cylindrical part 142 from which extends a lower frusto conical part 143 that converges to the aperture 15. The upper end of the cylindrical part 142 is sealed by a plug 144 which presents a socket 145. The insert 11 is secured to be carried concentrically under the cap 10 by the spigot 141 firmly engaging in the socket 145. If required the plug 144 can be omitted and the spigot 141 sealingly and firmly engaged in a socket presented by the upper tubular end of the cylindrical part 142. It will be appreciated that the socket and spigot coupling between the cap 10 and insert 11 can be reversed from that shown in Figure 10 so that the sealant 140 is moulded to present a socket with which a spigot provided on the insert 11 engages; such a modification is shown in Figure 11. In Figure 11 the sealant 140 is moulded to the underside of the cap 10 to form a cylindrical skirt 150 which presents a cylindrical socket 151. The upper end of the tubular part 142 of the insert 11 is sealed by a plug 144A which presents a frusto conical spigot 152. The spigot 152 is concentric within an outer wall 153 of the plug and spaced therefrom to form a tapered channel 154 of annular section. In fitting the insert 11 to the cap 10 of Figure 11, the spigot 152 is received in the cylindrical socket 151 as the skirt 150 is received simultaneously in the channel 154; as the socket and spigot are engaged, the spigot 152 is force fitted into the socket 151 causing the skirt 150 to become splayed from its initial cylindrical shape to a frusto conical shape within the confines of the channel 154 so providing secure frictional and mechanical engagement between the cap and the insert. The closures 8 shown in Figures 10 and 11 will be fed to the closure locator 5 in a similar manner to that previously described with reference to Figures 1 to 6, the inserts 11 having previously been press fitted to the caps 10 to interengage the sockets and spigots and provide flexible necks 160' and a clearance 160 between the underside of the caps 10 (and the sealant thereon) and the upper ends of the inserts 11 carried thereby. If required an adhesive can be provided between the co-operating sockets and spigots or local heating applied to fuse the co-operating sockets and spigots together but it is preferred that in each case the inserts are flexibly mounted on the caps, conveniently through the resilient nature of the sealant material.

It is recognised that the headspace 32 in the bottle will usually be quite small and preferably therefore the amount of froth which is developed on opening of the bottle is arranged so that there is unlikely to be an overspill of froth from the bottle under normal conditions of dispensing. This may be achieved by determining the gas pressure in the secondary chamber 14 so that the power of the gas and/or beer jet which results through the restricted aperture will penetrate the beer 21 to a depth which will cause gas to be liberated from solution in an upper part only of the volume of beer in the bottle. For example with the sealed bottle pressurised to say 2 bar it may be that when the bottle is opened the resulting pressure differential develops a jetting effect through the aperture 15 which is adequate to liberate gas in solution from, say, only the upper third of the volume of beverage in the bottle and thereby a relatively small

head of froth develops. Alternatively if the bottle is pressurised to, say, 4 bar the jetting effect may have adequate power to be effective throughout the full depth of the beverage in the bottle and considerable quantities of gas may be liberated throughout the whole volume of the beverage to create excessive frothing (depending, of course, upon the viscosity, prevailing temperature, geometry of the restricted aperture and nitrogenation conditions of the beverage). If gas in solution is liberated by the jetting effect from only a relatively small proportion of the volume of beverage in the bottle to create a relatively small amount of froth in the headspace 32, it is unlikely that this will be detrimental to the quality of the head of froth on the beverage when it has been dispensed from the bottle. The reason for this is believed due to the peculiarities which a conventional bottle neck shape has on the beverage as it is poured from the bottle into a glass for consumption, where a secondary initiation of froth develops as gas in solution is further liberated during the pouring by reaction of the beer with the froth that was initially formed on opening of the bottle.

In the modification shown in Figure 9 the hollow insert 11 having the secondary chamber 14 is formed as a plastics moulding discrete and separate from the closure cap 10. The insert 14 has a hollow generally cylindrical body 100 within which is provided the secondary chamber 14 and a bottom end 101 of which tapers to the restricted aperture 15. The upper end 102 of the insert body has projecting therefrom, typically three or four, circumferentially spaced and radially extending fins or flanges 103. The diameter of the insert 11 across the fins 103 is slightly greater than that of the mouth of the open top 20C of the bottle so that the insert can be received through the open top of the bottle and held or supported by bottom edges 103A of the fins abutting the rim of the bottle about its open top 20C. A beverage package comprising the insert 11 and separate cap 10 as shown in Figure 9 may be formed using apparatus substantially as shown and described with reference to Figures 1 to 6 with modifications to the method as follows. The caps 10 without the hollow inserts are fed to the closure locators 5. As the open topped bottles 20 charged with beer 21 are fed to the platforms 6 of the sealing stations, each bottle receives a hollow insert 14 within its open top so that the insert is supported by its fins 103 on the rim of the bottle as shown in Figure 9. In this latter, initial, condition of the insert the restricted aperture 15 is held clear of the beer 21 so that the secondary chamber 14 is in direct communication with the headspace in the bottle 20. The insert 14 is thus carried by the bottle 20 into the pressure chamber 25 which chamber is then closed and sealed with the cap 5 overlying, but spaced from, the open top of the bottle and the insert therein. The pressure chamber 25 is now exhausted and pressurised separately as previously described to the predetermined pressure thereby pressurising the primary chamber in the bottle and the secondary chamber 14 to that pressure. Within the predetermined pressure of the closed chamber 25, the closure locator 5 and bottle 20 are displaced towards each other for the cap 5 to engage the upper end 102 of the insert and push the insert 11 further into the open top of the bottle. As the insert 11 is pushed into the bottle its plastics fins 103 flex or resiliently deform against the inner face of the wall of the bottle neck to provide a friction fit which retains the insert in a final position in the bottle. When the cap 10 engages the rim of the bottle opening it is crimped or otherwise sealingly secured to the bottle neck as shown at 10' to form and maintain the sealed headspace in the bottle. During the push fitting of the insert 11 into the bottle the restricted aperture 15 is displaced sufficiently so that it becomes submerged in the beer 21 as shown at 15'. The sealed package is thus formed and the chamber 25 can be de-pressurised for removal of the package. It will be appreciated that the insert 11 can be retained in its final position in the sealed bottle otherwise than by use of the fins 103, the fins 103 are preferred however as providing convenient passages therebetween through which the beer 21 can be poured from the bottle without removing the insert.

Figures 12 to 17 relate to a second embodiment of the beverage packaging apparatus of the present invention in which Figure 12 diagrammatically shows the general arrangement of that embodiment and Figures 13 to 17 sequentially illustrate successive stages of the beverage packaging at a sealing station 1 to provide a sealed bottle containing the beverage. Those having an understanding of the first embodiment in Figures 1 to 6 will readily appreciate the features which distinguish the second embodiment, especially in the formation of the pressure chamber and the manner in which the bottle is handled whilst at the sealing station. In this second embodiment the closure 8 comprising the insert 11 and cap 10 are substantially as previously described with reference to Figure 10.

In Figure 12 the empty open topped glass bottles 20 are conveyed in an upstanding condition successively through a conventional fill bottling machine 200 from which each bottle emerges with its beverage charge 21. The charged bottles 20 are then conveyed successively as indicated by the arrows 201 to a sealing machine 202. A bulk supply of the hollow inserts 11 of the kind shown in Figure 10 is provided in a hopper 203 and inserts 11 are fed therefrom to an unscrambling unit 204 by which they are similarly orientated to have their restricted aperture 15 directed downwardly. The so orientated inserts are transferred by a conveyor 204' sequentially and in an upstanding condition through a starwheel 205 to a cap connector unit 206. The unit 206 has a hopper 207 which contains a bulk supply of metal crown caps 10 having the sealant 140 moulded thereto as shown in Figure 10. These caps are fed from the hopper through a conventional cap unscrambler 208 by which they are similarly orientated with their spigots 141

directed downwardly and in this condition the caps are fed to the unit 206. The unit 206 press fits the caps 10 successively to the hollow inserts 11 to form the socket and spigot engagement therebetween in the manner previously discussed with reference to Figure 10. The closures 8 which result from a cap 10 and a hollow insert 11 press fitted thereto are transferred succesively by a chain conveyor 209 and a starwheel 210 to the sealing machine 202 simultaneously with charged bottles 20 arriving from the filling machine 200.

The sealing machine 202 is in the form of a carousel which rotates about a vertical axis 202' and carries a circumferentially disposed array of identical sealing stations 1 (in the manner discussed in the first embodiment). The structure and operation of each sealing station 1 as it rotates on the carousel of the second embodiment will now be described with reference to Figures 13 to 17.

The carousel of the sealing machine 202 has a vertical support 211 which rotates about the vertical axis 202' carrying with it each sealing station 1 and a horizontal platform 212 on which a bottle 20 with its beverage charge is received and carried in an upstanding condition. Each bottle 20 is moved by the platform 212 circumferentially directly below a workstation 1 in a constant horizontal plane throughout the sealing operation. The sealing or workstation 1 has the vertically extending tubular shroud 2 which in this embodiment is displaceable vertically relative to the rotating support 211 under control of a roller 213 which engages with and moves circumferentially relative to a stationary cam track 214. Extending within the shroud 2 is the vertical shaft 3 which is sealed relative to the shroud 2 and is slidable vertically relative thereto under control of a roller 215 which engages with and moves circumferentially relative to a stationary cam track 216. The lower end of the shaft 3 has the closure locator 5 in the form of a crowning head which includes a magnet by which a metal cap 10 of a closure 8 may be picked up and held firmly in the crowning head 5. Extending through the shaft 3 and the shroud 2 is a gas exchange conduit 217 which opens at its lower end adjacent to the crowning head 5 within the confines of the shroud 2 and at its upper end is connectable by way of valves (not shown) to a source of nitrogen gas under pressure or to vacuum. The workstations 1 are carried circumferentially of the carousel in the direction of arrows 218 in Figure 12. In the position of a workstation 1 shown in Figure 13 a closure 8 is delivered by the starwheel 210 to a position beneath the crowning head 5 at which position the closure 8 is lifted from the starwheel 210 by cams (not shown) to engage the crowning head and be held firmly by the magnet of that head reacting on the metal cap 10.

The workstation 1 now rotates to the position shown in Figure 14 and during this rotation a bottle 20 with its beverage charge 21 moves on to the platform 212 directly beneath the crowning head 5 as the shroud 2 is displaced downwardly for enclosing the upper part of the bottle 20 under control of the roller 213 and cam track 214. During this downward displacement of the shroud 2, nitrogen gas under pressure is introduced into the conduit 217 and therethrough into the lower end of the shroud 2 to purge the shroud and the open top of the bottle of atmospheric oxygen. This purging continues as the workstation 1 rotates to the position shown in Figure 15 where the shroud 2 is displaced downwardly under control of the roller 213 to a position in which an annular lower end 2A of the shroud abuts an external shoulder 20D which the bottle presents in tapering from its cylindrical body 20A to its neck 20C. The lower end 2A of the shroud carries an annular seal 2B which engages with the bottle shoulder 20D to form a sealed pressure chamber 25 between the shroud 2 and the upper part of the bottle 20 whilst the lower part of the bottle is maintained open to atmosphere. The crowning head 5 and the closure 8 carried thereby are maintained clear of the open top 20C of the bottle and within the pressure chamber under control of the roller 215 and its cam track 216. With the workstation 1 in the condition shown in Figure 15 nitrogen gas under pressure is admitted through the conduit 217 in a similar manner to the first embodiment to pressurise the chamber 25 and thereby the primary chamber in the bottle 20 and the secondary chamber in the insert 11 to the required pressure. Also if required, and in a similar manner to that described for the first embodiment, prior to the aforementioned pressurisation of the chamber 25, that chamber may be connected through the conduit 217 to a vacuum for the purpose of withdrawing atmospheric oxygen (particularly from the hollow insert 11).

As the workstation 1 rotates from the position shown in Figure 15 to that shown in Figure 16 and with the pressure chamber 25 pressurised with nitrogen gas, the shaft 3 is displaced downwardly relative to the shroud 2 (under control of the roller 215 and its cam track) thereby moving the crowning head 5 downwardly in the shroud 2 so that the insert 11 enters the neck of the bottle through its open top and dips into the beverage 21 as the cap 10 engages the top lip of the bottle 20. Final downward movement of the shaft 3 under control of the roller 215 causes the cap 10 to be crimped on to the rim of the bottle and sealed thereto in conventional manner.

As the workstation rotates from the position shown in Figure 16 to that shown in Figure 17 the conduit 217 is closed to pressurised nitrogen gas and the shroud 2 is displaced upwardly relative to the support 211 to open the pressure chamber 25 from the shoulder 20D of the bottle causing the pressure chamber to de-pressurise whilst the crowning head 5 is maintained on the crown cap 10. As the shroud 2 is raised clear of the sealed bottle package 20, the crowning head 5 is also raised clear of the bottle package under control of the roller 215 so that the sealed bottle can be removed from the platform 212 by an out-feed starwheel 300 (Figure 12) as the workstation 1 completes its circuit. The work-

station is now moved by the carousel back to the position shown in Figure 13 to pick up another closure 8.

The main difference between the first embodiment and the second embodiment is that in the latter the pressure chamber 25 is formed between the shroud 2 and the upper part of the bottle 20 by abutment between the lower end 2A of the shroud and the shoulder 20D of the bottle. This has the considerable advantage that the apparatus can accommodate different sized bottles provided that the lower end of the shroud 2 is capable of abutting the external shoulder of a bottle to form the seal therewith. It is appreciated that with different sized bottles the height above the stand 212 of the position at which the lower end 2A of the shroud will sealingly engage with the shoulder 20D of a bottle may vary from one bottle to another; to compensate for this the lower end of the shroud 2 may be spring loaded or resiliently mounted vertically relative to the roller 215 (and thereby relative to the carousel support 211) effectively to provide a vertical resilience for the lower end of the shroud in its sealing engagement with the bottle. This resilient mounting is conveniently achieved by having the tubular structure for the shroud 2 of telescopic form with the telescopic parts thereof spring loaded vertically relative to each other (such spring loading is indicated generally at 301 in Figure 16). Similarly the crowning head 5 will usually be spring or resiliently mounted on the shaft 3 to compensate for bottles of different heights on the stand 212. The formation of the pressure chamber 25 to enclose only the upper part of the bottle also has the advantage that a smaller pressure chamber can be used (in comparison with that shown in Figure 3) with a consequent saving both in material and in the nitrogen gas which is utilised. It will also be noted that in the second embodiment the bottle is maintained in a constant horizontal plane, this permits a control system to be used which is relatively simpler in comparison with that in which the bottle has to be raised and lowered during sealing (as in the first embodiment).

## Claims

1. A beverage package comprising an open top bottle (20) having a primary chamber containing beverage (21) having gas in solution therewith, a cap (10) sealing said open top and removable for dispensing of the beverage (21), a headspace (32) being provided in the bottle (20) above the beverage (21) containing gas at a pressure greater than atmospheric; a hollow insert (11) carried by the cap (10), and having a secondary chamber (14), said secondary chamber (14) containing at least gas at pressure greater than atmospheric and the insert (11) having a restricted aperture (15) located beneath the surface of the beverage (21) through which, upon opening of the primary chamber (32) to atmosphere and in response to a pressure differential developed thereby, gas and/or beverage in the secondary chamber (14) is directed into the beverage (21) in the primary chamber to form, or assist in the formation of, froth on said beverage, and wherein the cap (10) has a sealant (140) secured thereto and forming a seal between the cap and the bottle, said sealant (140) being moulded to present a part thereof with which the hollow insert mechanically engages to be carried by the cap.

2. A package as claimed in claim 1, in which the insert (11) is flexibly mounted relative to the cap.

3. A package as claimed in claim 2, in which said flexible mounting is provided by resilience in said sealant (140) to which the insert is engaged.

4. A package as claimed in any one of claims 1 to 3, in which the sealant (140) is moulded to present one of a socket part and a spigot part (160') and the hollow insert presents the other of said parts and said mechanical engagement is by socket (145) and spigot (160') coupling between the respective parts of the sealant and the insert.

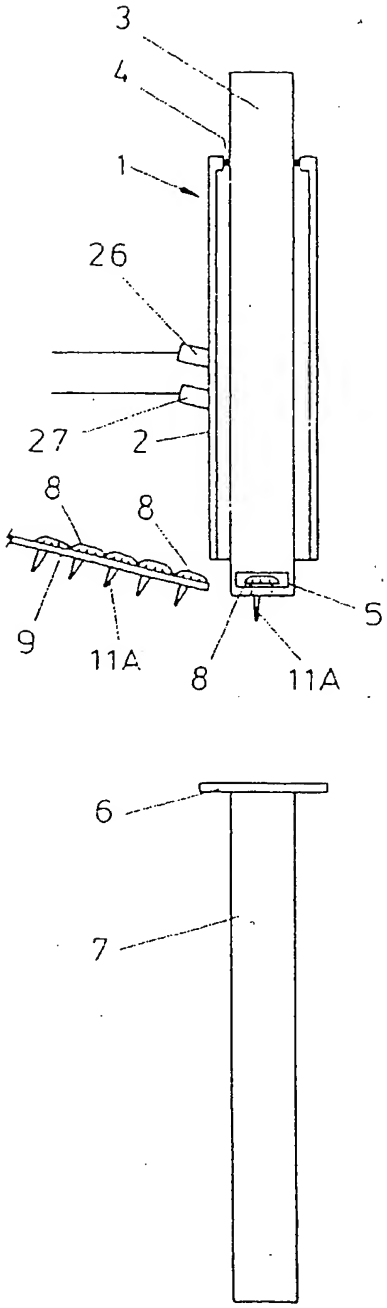



FIG. 1

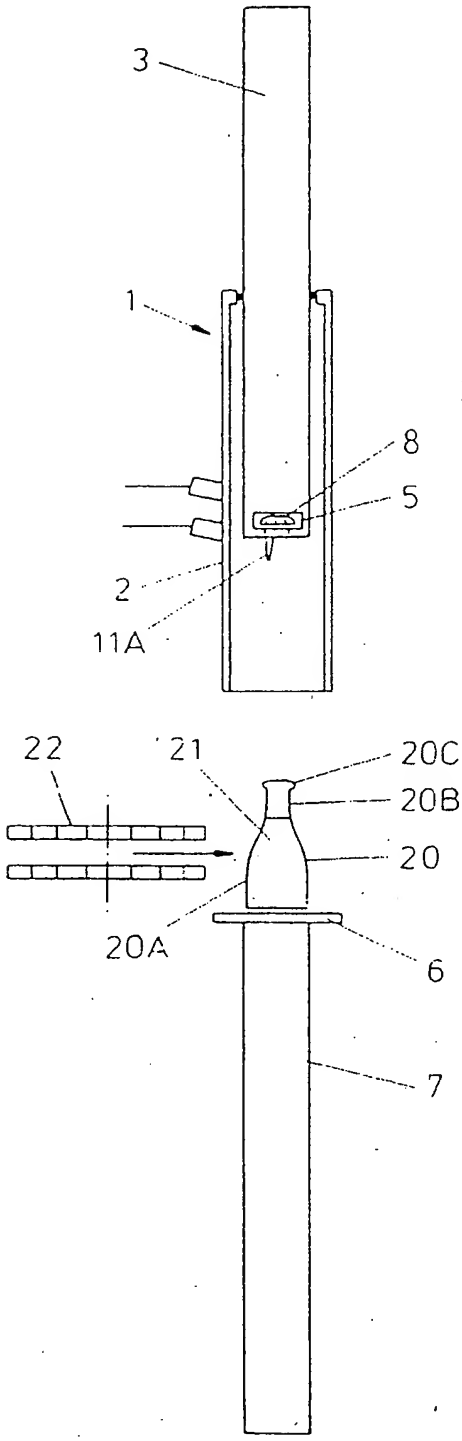



FIG. 2

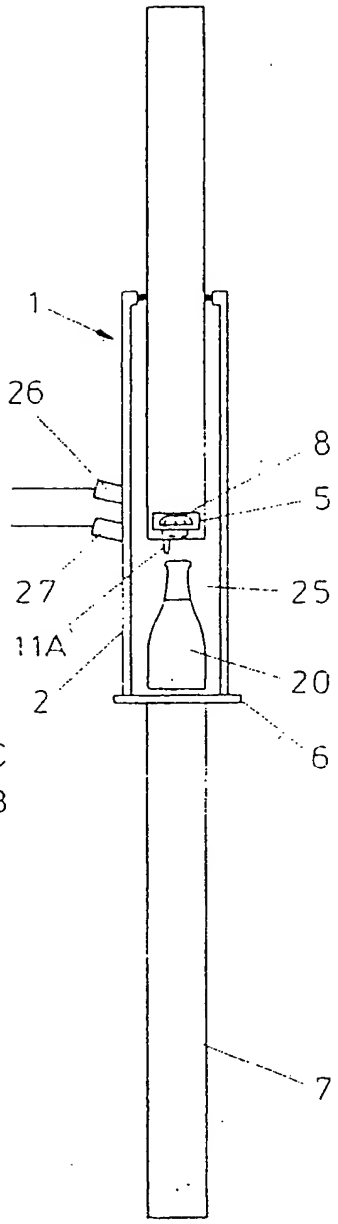



FIG. 3

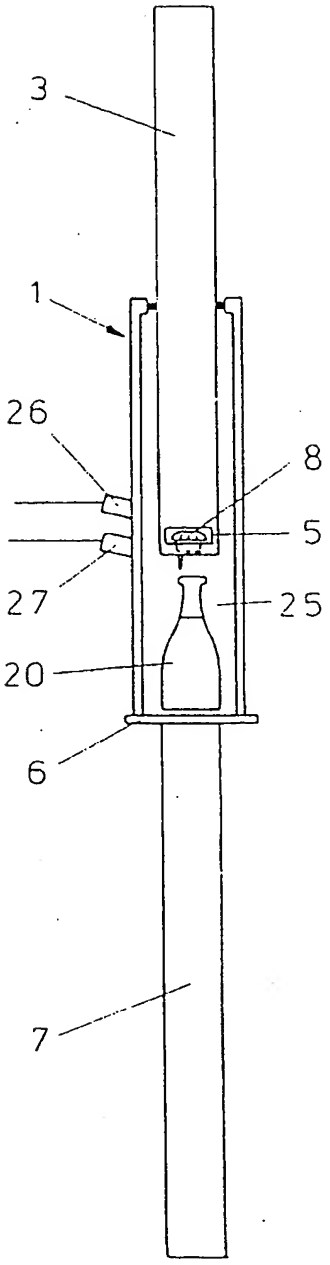



FIG. 4

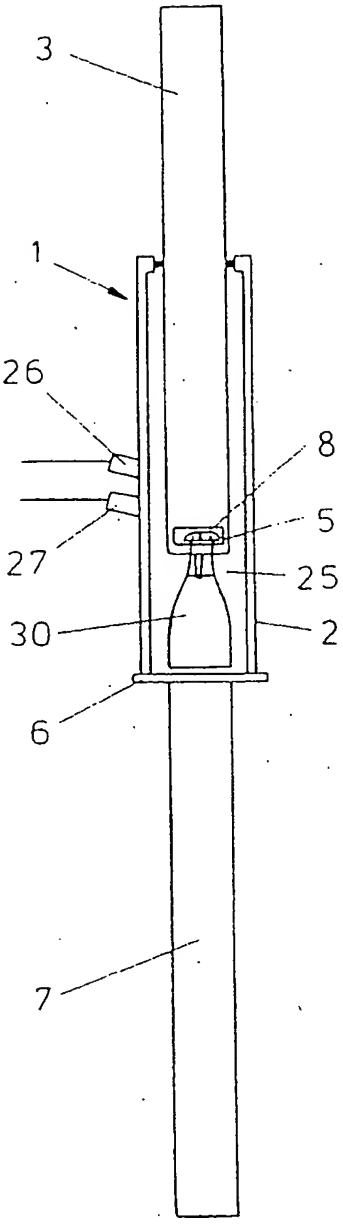



FIG. 5

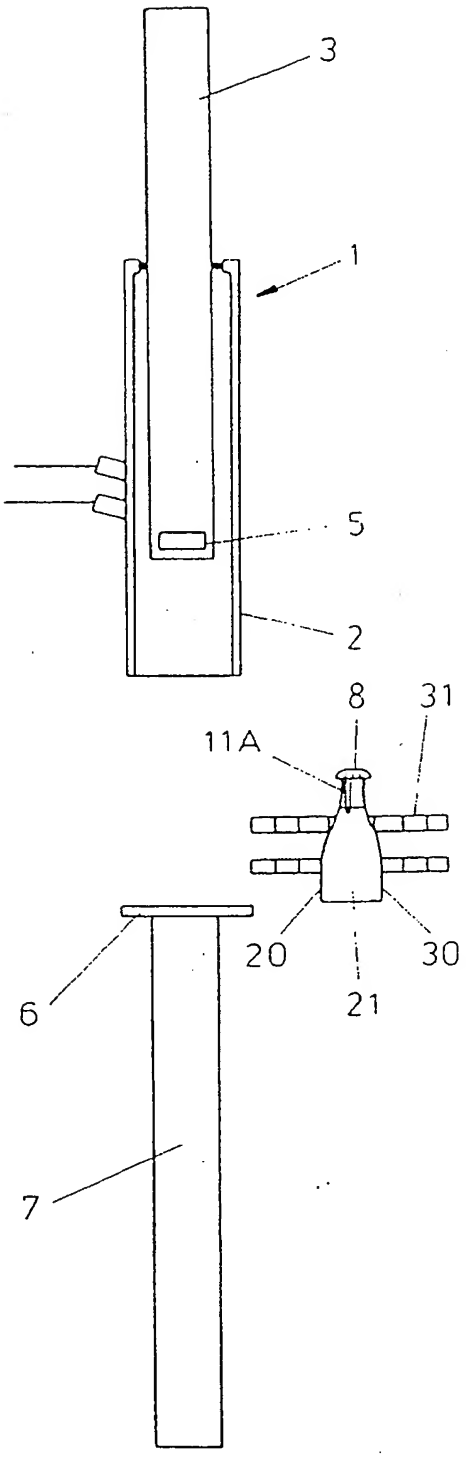



FIG. 6

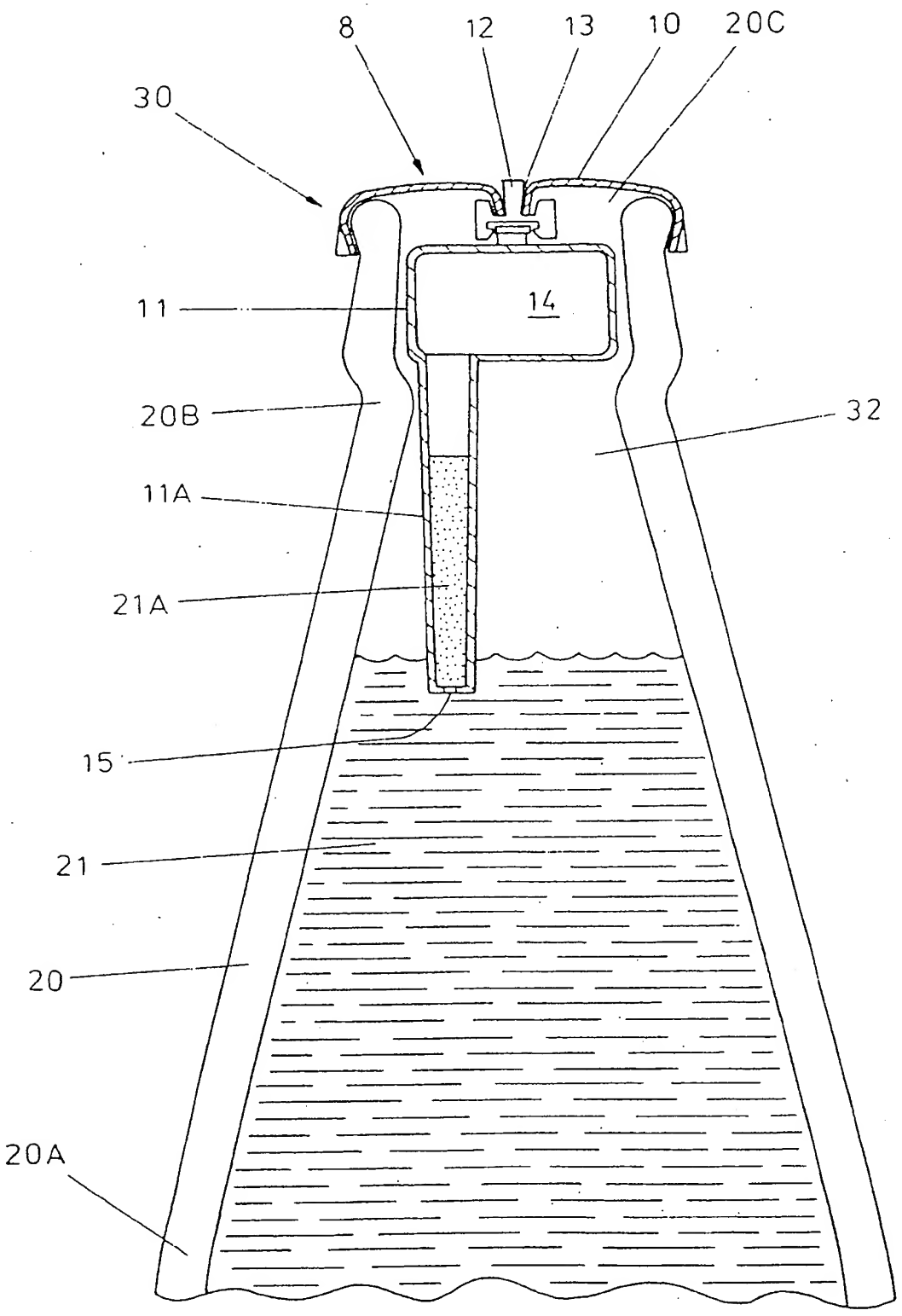



FIG. 7

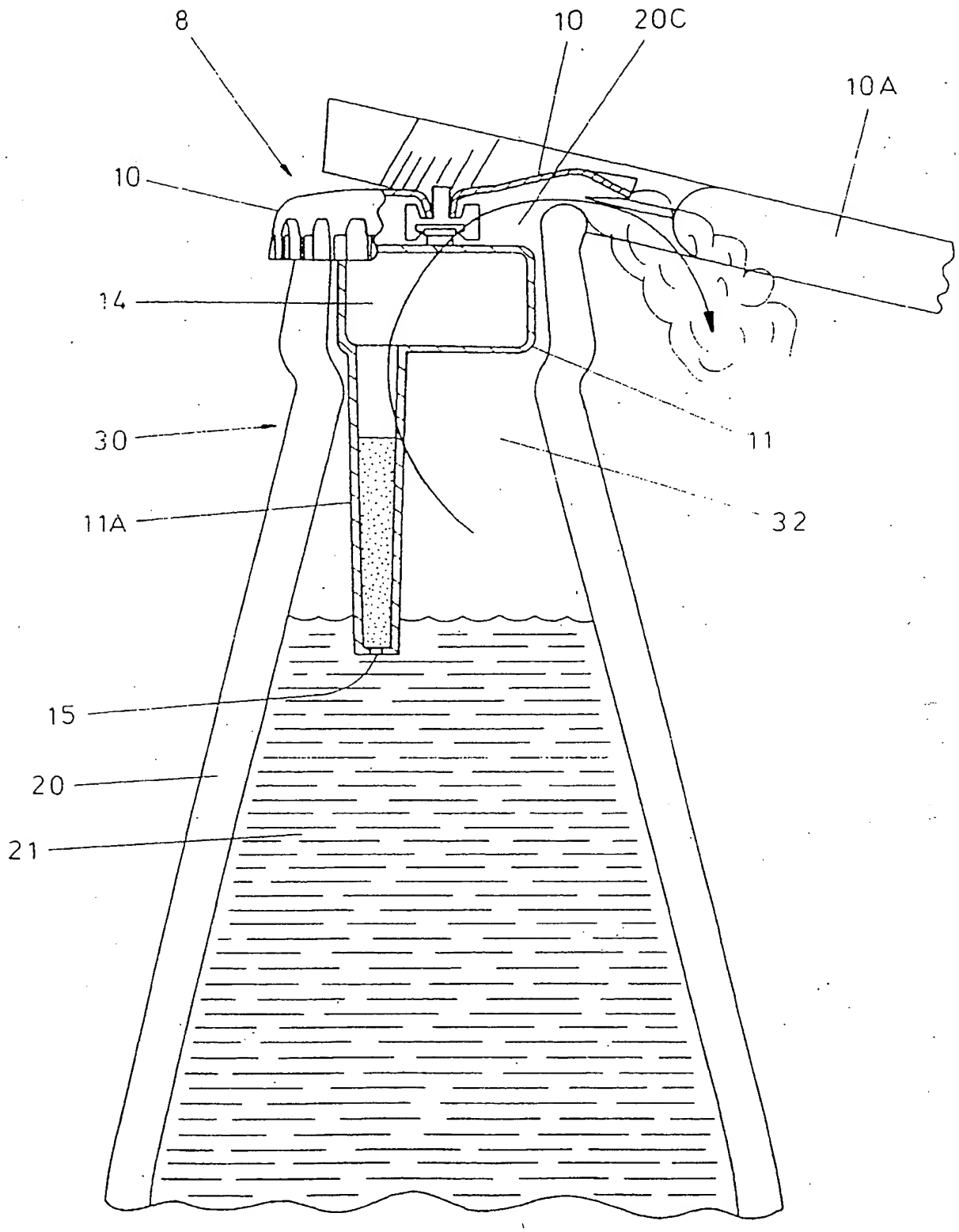
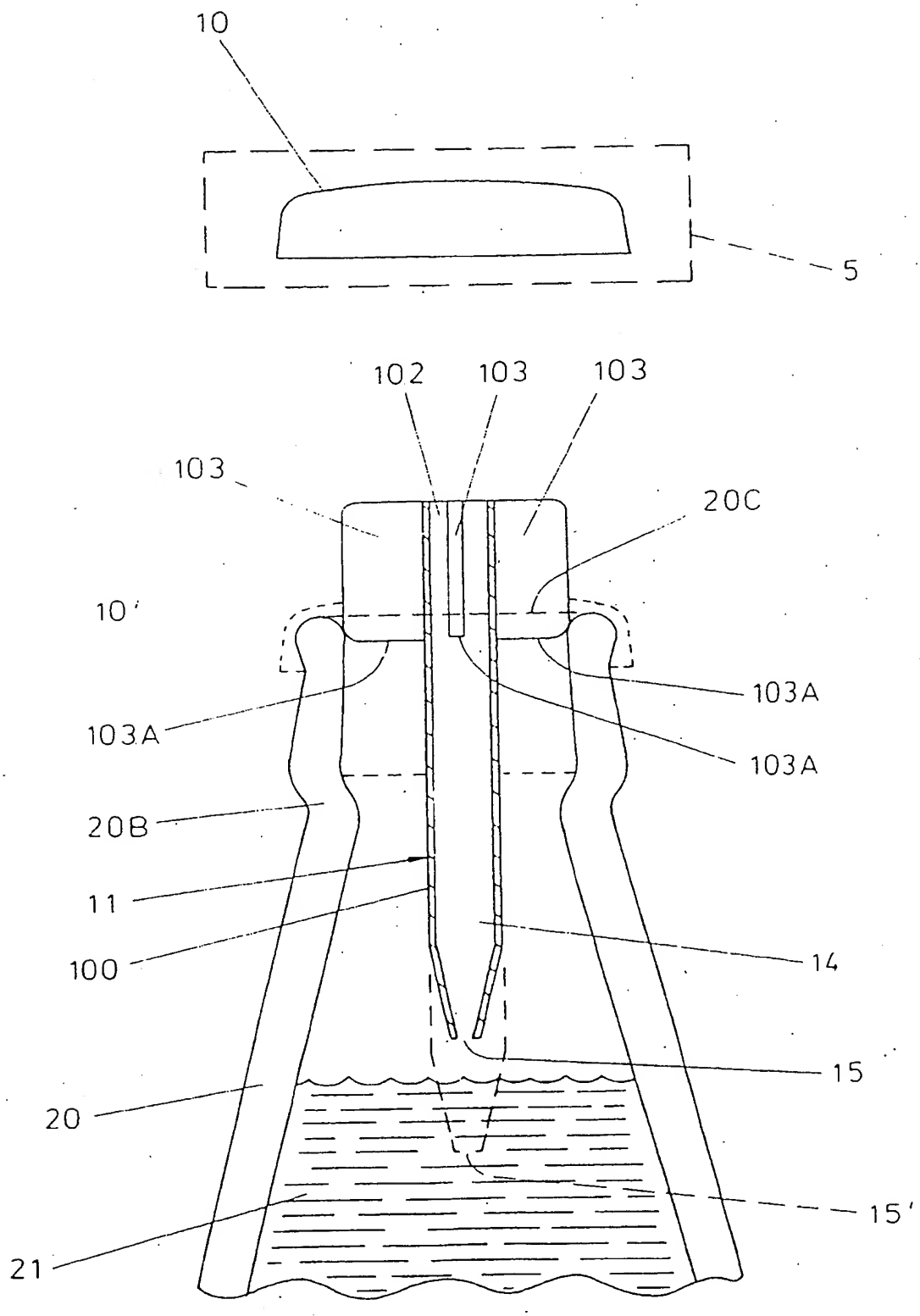



FIG. 8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5
102
103
103
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10'
103A
103A
103A
20B
11
100
14
15
20
15'
21

FIG. 9

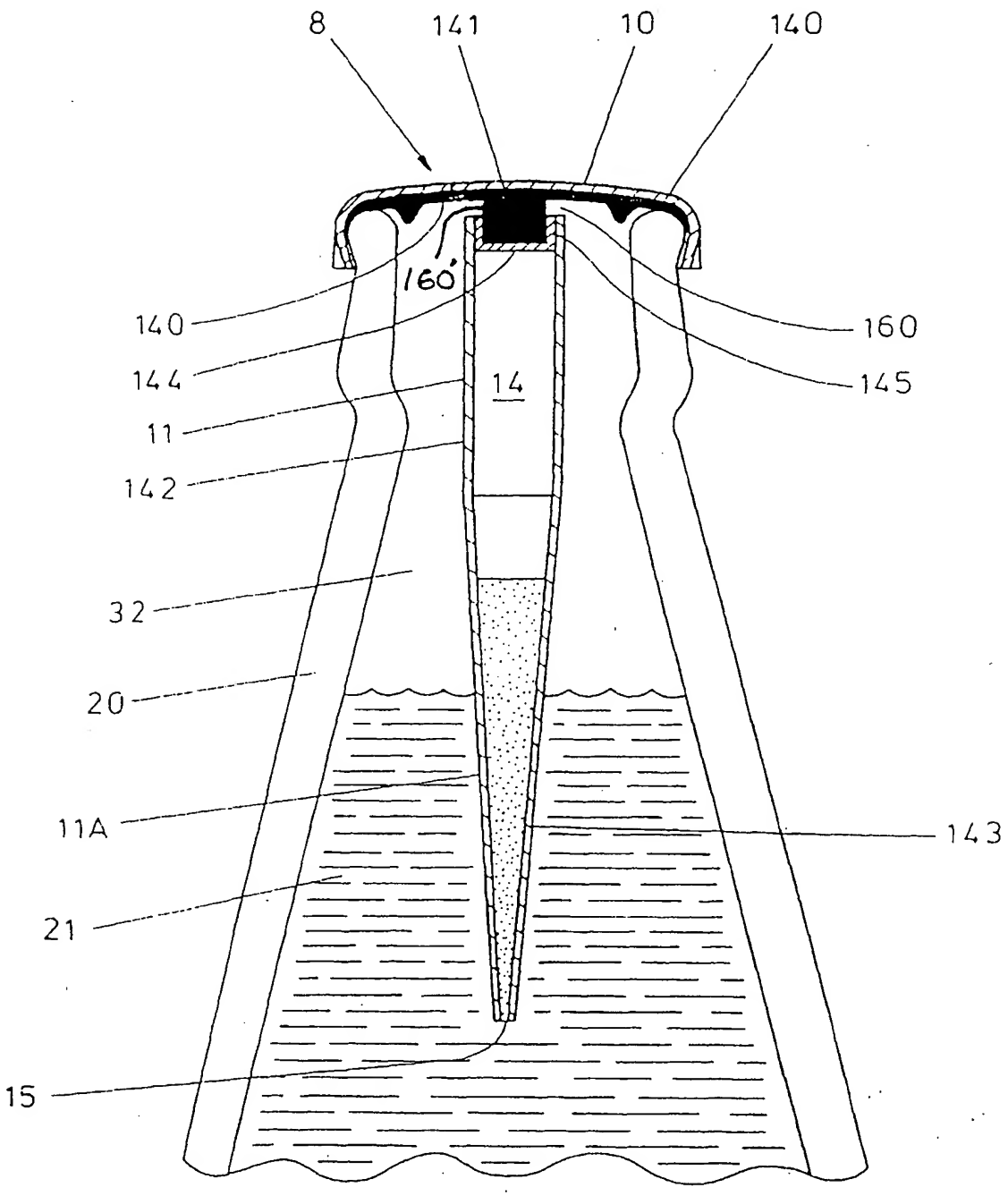



FIG.10

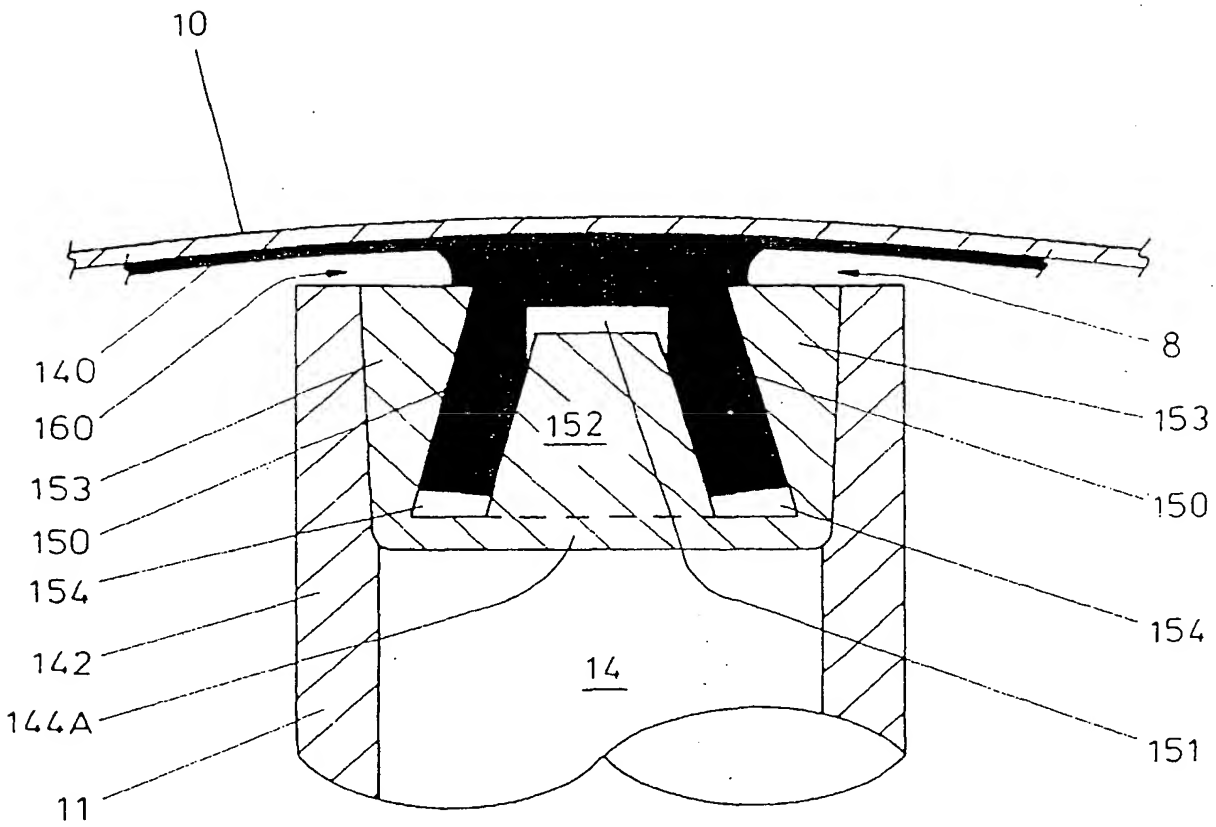
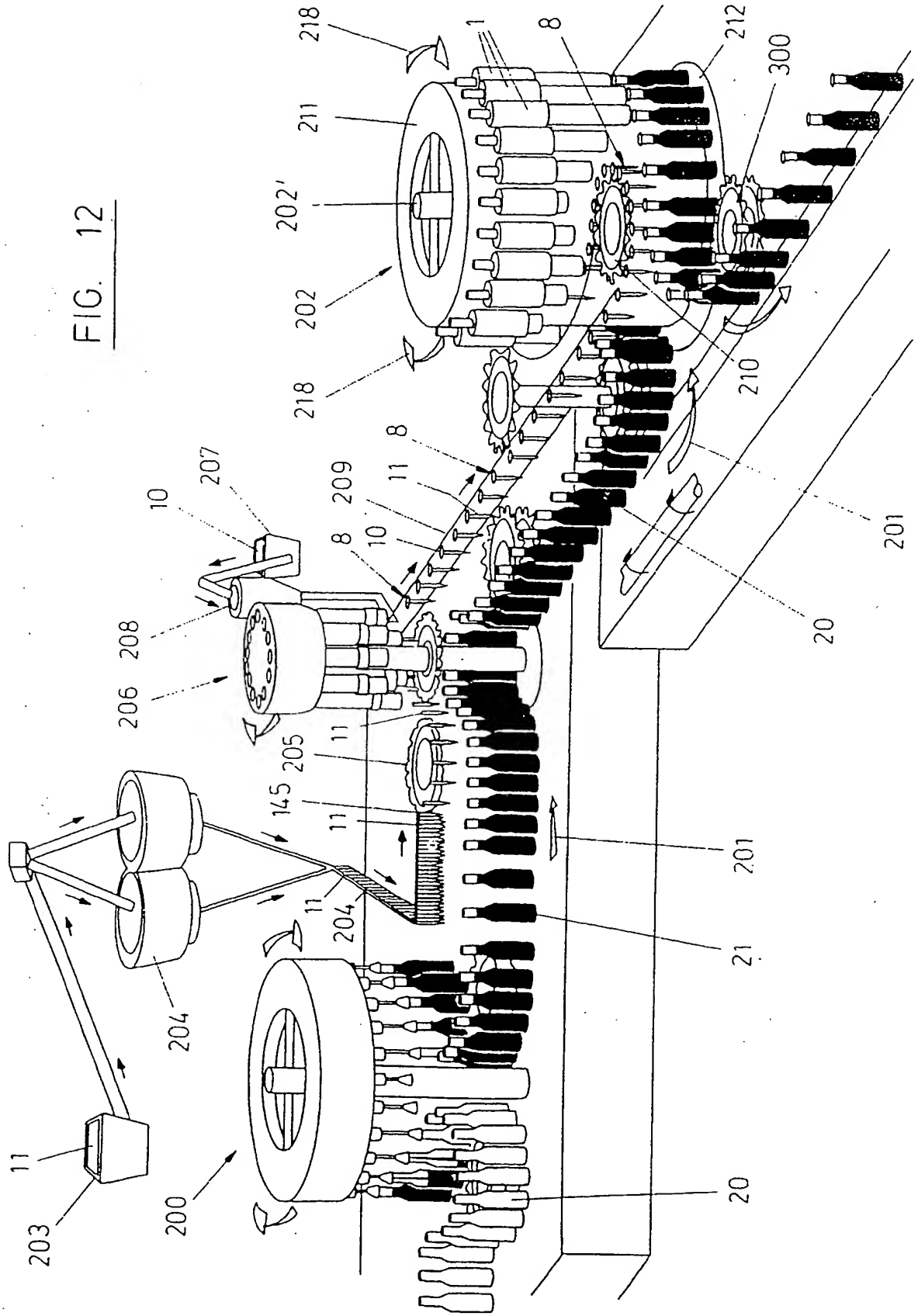



FIG. 11.

FIG. 12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211
202'
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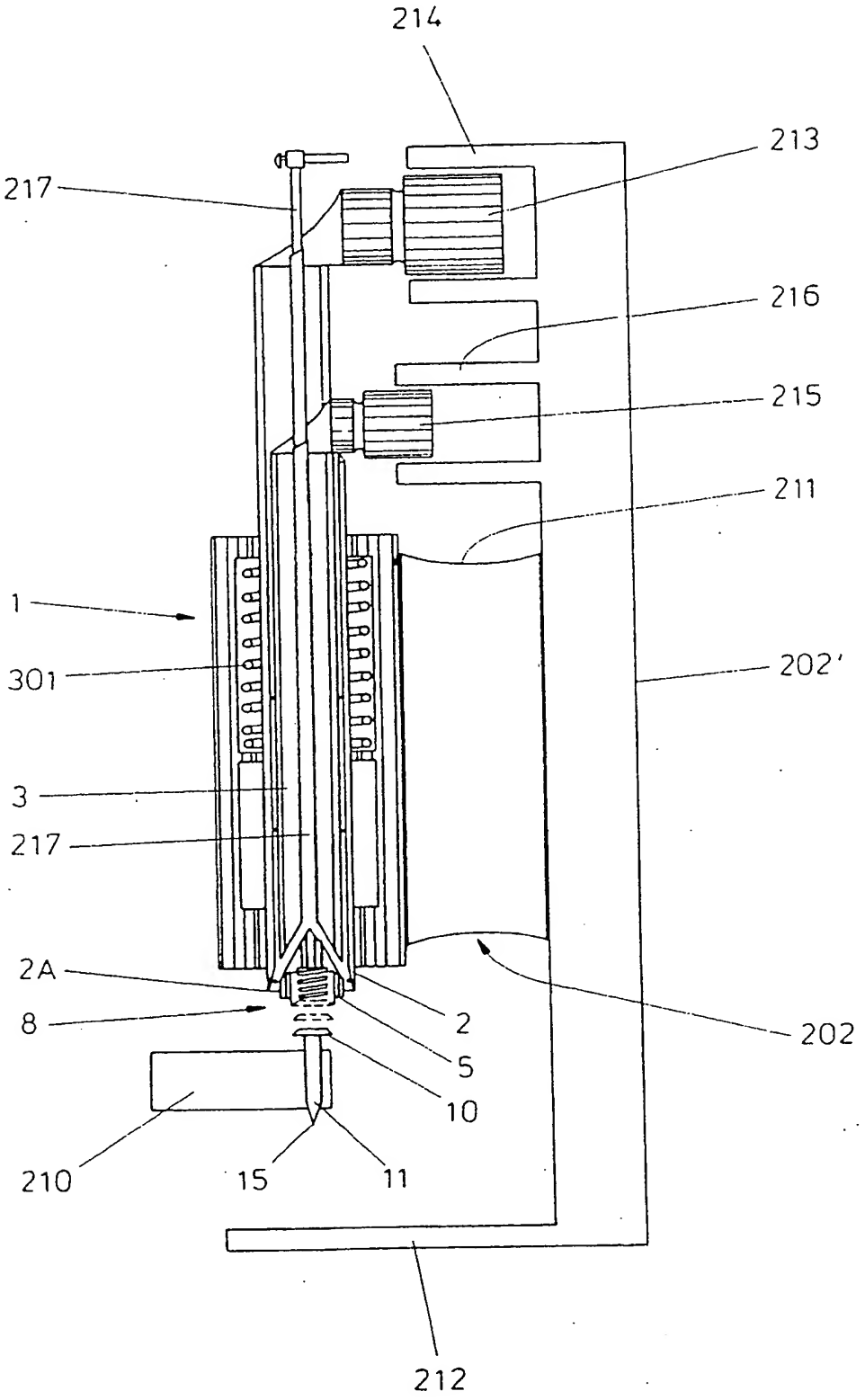


FIG. 13

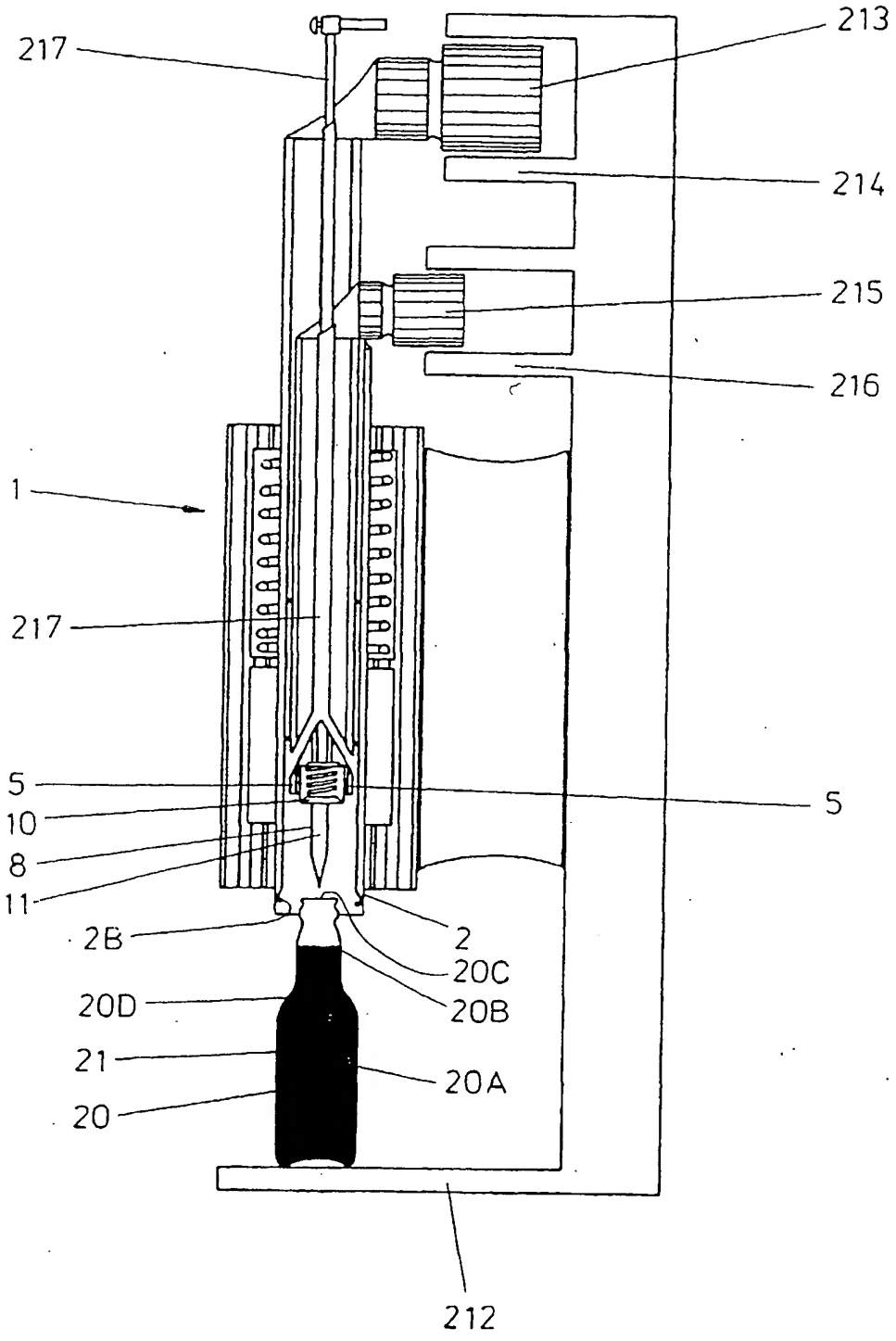


FIG. 14

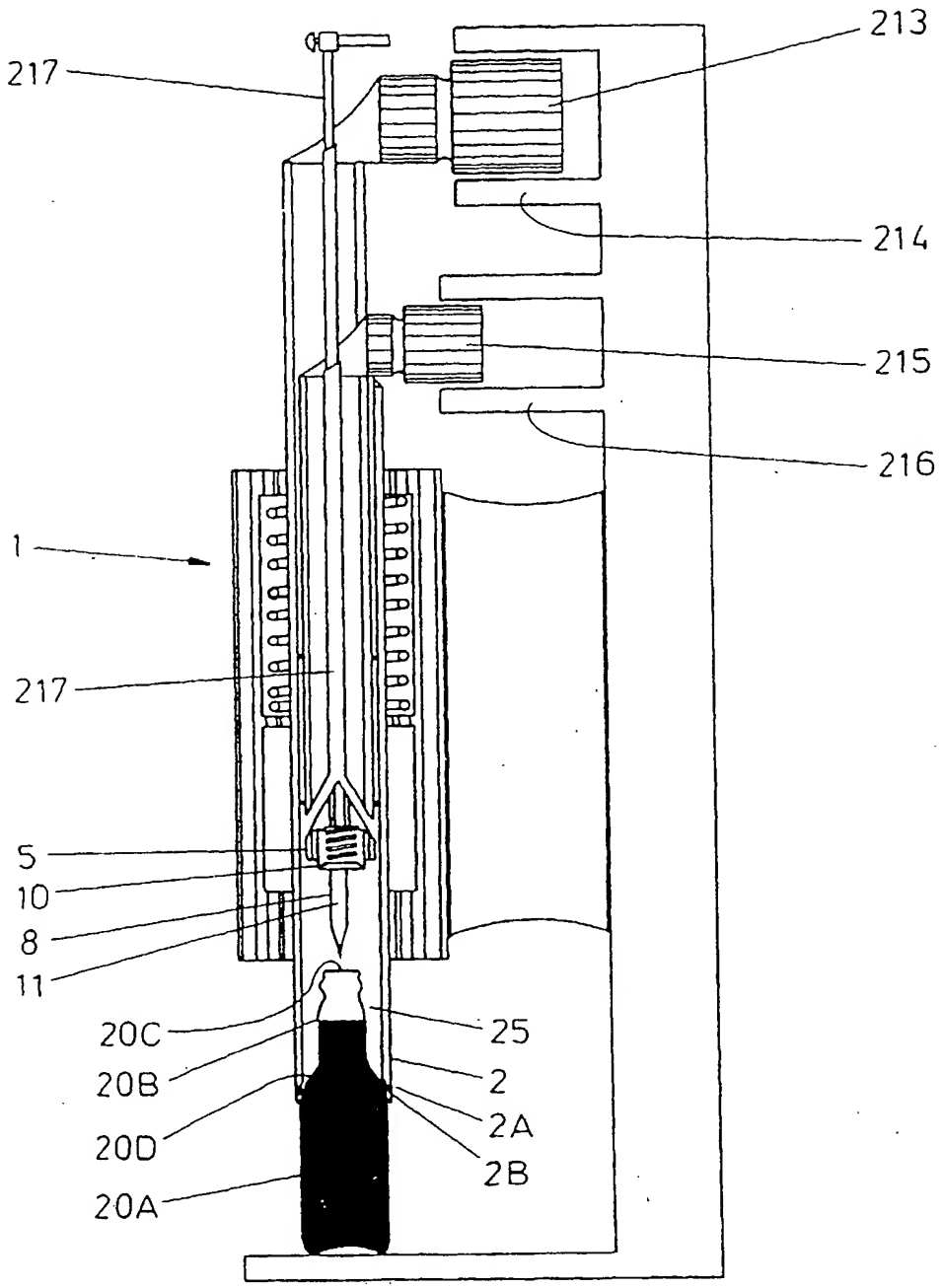


FIG. 15

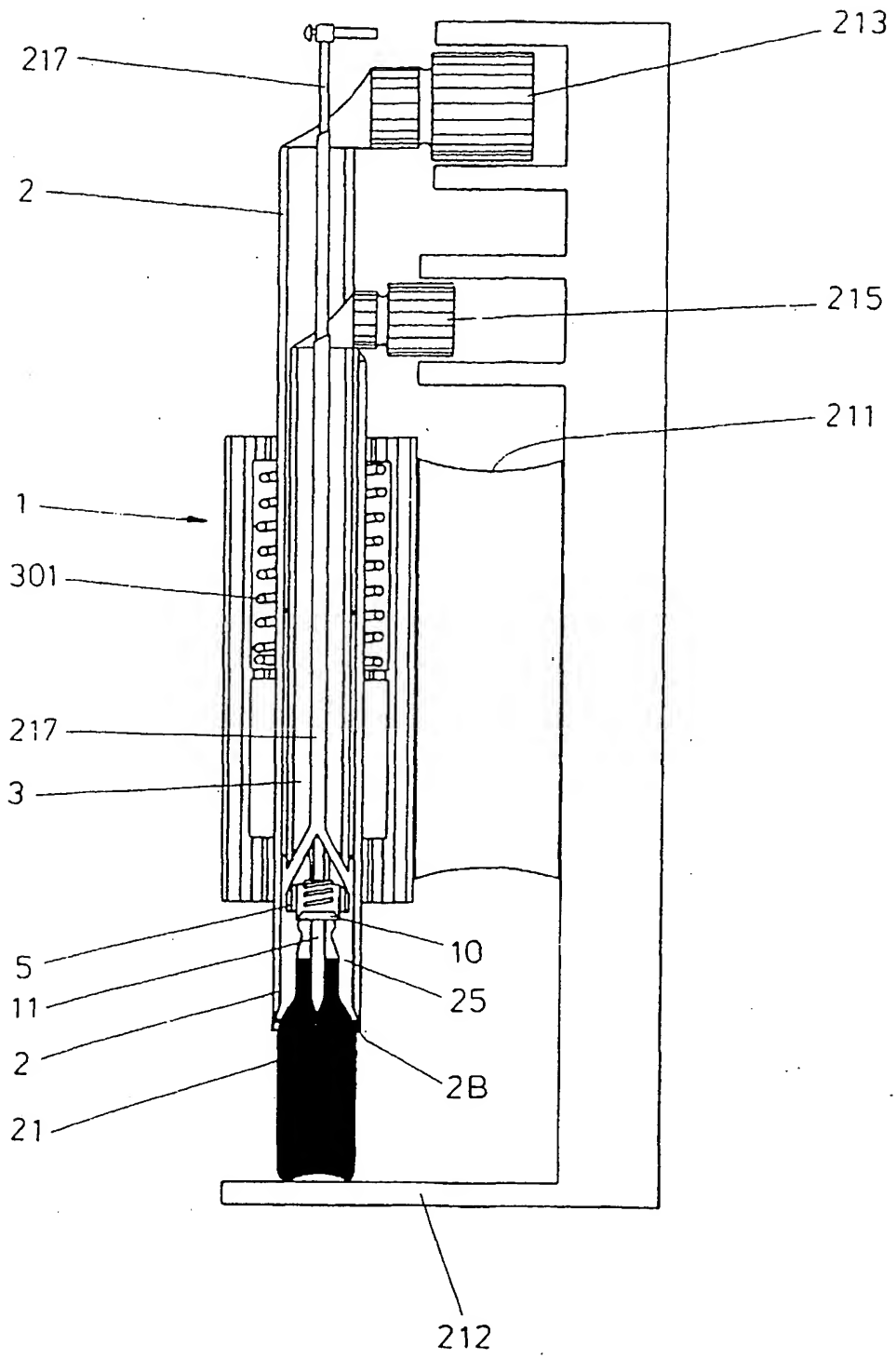


FIG. 16

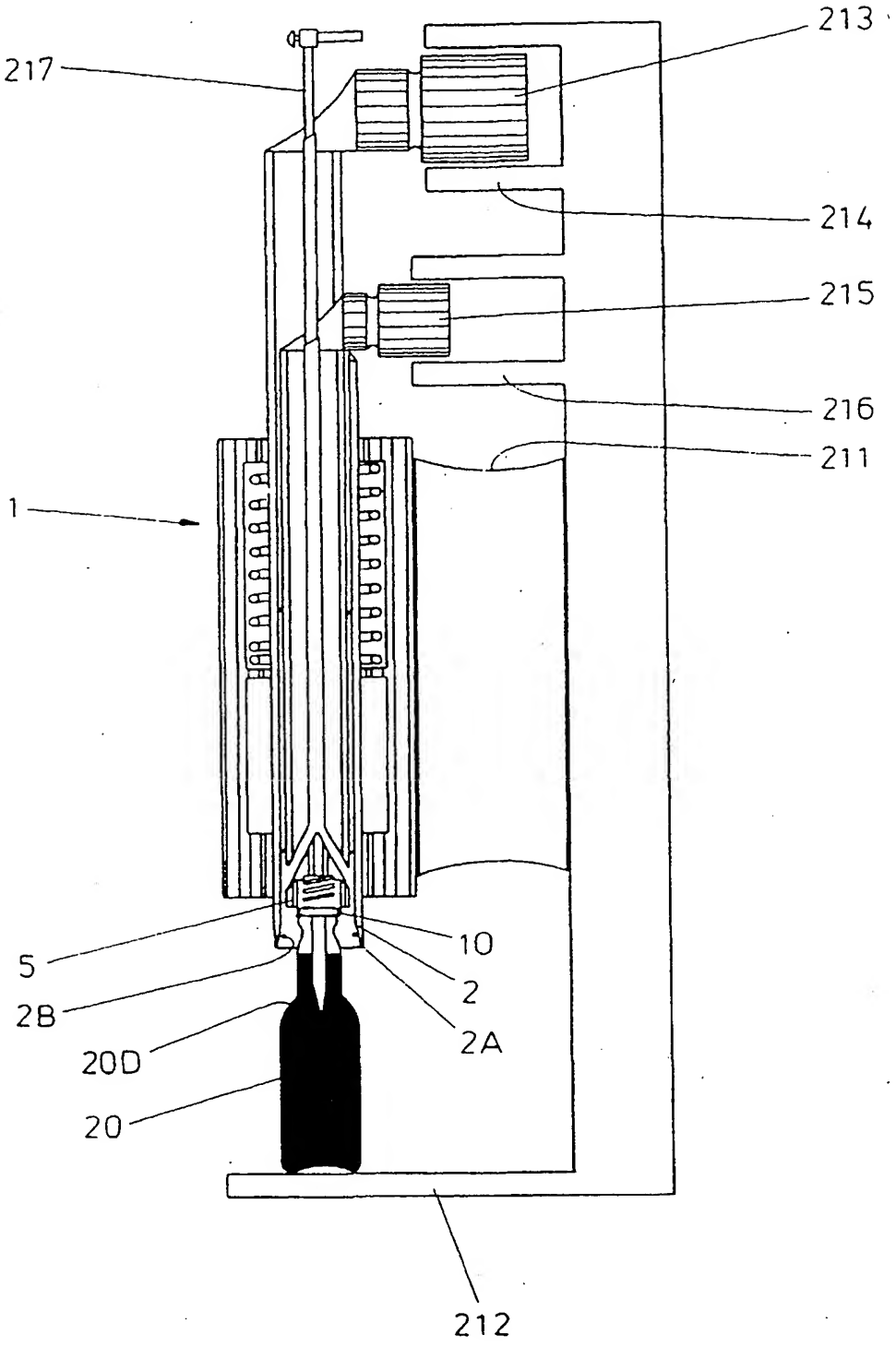


FIG. 17

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 97 11 8697

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
|---|---|---|---|
| D,A | GB 1 266 351 A (ARTHUR GUINNESS SON & COMPANY (DUBLIN) LIMITED) * page 2, line 126 - page 3, line 16; figures 1,2 * | 1-4 | B67B3/00<br>B67B3/02<br>B65D79/00 |
| A | WO 94 16966 A (CPB INNOVATIVE TECHNOLOGY LIMITED) 4 August 1994 * figures 14-17 * | 1 | |
| D,A | GB 2 256 628 A (GUINNESS BREWING WORLDWIDE) | | |

| TECHNICAL FIELDS SEARCHED (Int.Cl.6) |
|---|
| B67B<br>B65D<br>B67C |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 15 December 1997 | Martínez Navarro, A. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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